CLAIMS

1. A multimode interference based coupler comprising:

(a) at least one input access waveguide for inputting an input optical signal into a first end of the multimode interference based coupler;

(b) at least one output access waveguide for outputting images of the input optical signal from a second end of the multimode interference based coupler; and

(c) a multimode region coupling the one or more input waveguides to the one or more output waveguides through which the input optical signal propagates from the first end to the second end along a propagation axis and is reimaged at the one or more output access waveguides, wherein

(i) the multimode region has two opposing sidewalls which define a width of the coupler at each point along the propagation axis;

(ii) at least one of the sidewalls of the multimode region has a non-linear taper inward toward the opposing sidewall such that the coupler has an average width along the propagation axis that is less than the average width had the sidewalls both been straight lines; and

(iii) the sidewalls are smoothly continuous with continuous derivates along the propagation axis.

2. The multimode interference based coupler of claim 1, wherein both sidewalls have non-linear inward tapers toward the opposing sidewall with the taper of both sidewalls being symmetric reflections about a center line along the propagation axis.

3. The multimode interference based coupler of claim 2, wherein the tapers have a single extrema within the multimode region where the derivative along the propagation axis is zero.

4. The multimode interference based coupler of claim 2, wherein the coupler has equal widths at the first end and the second end.

5. The multimode interference based coupler of claim 3, wherein the coupler has equal widths at the first end and the second end.

6. The multimode interference based coupler of claim 4, wherein the two sidewall tapers are symmetric about a center line, orthogonal to the propagation axis, midway between the first end and the second end of the coupler.

7. The multimode interference based coupler of claim 5, wherein the two sidewall tapers are symmetric about a center line, orthogonal to the propagation axis, midway between the first end and the second end of the coupler.

8. The multimode interference based coupler of claim 4, wherein the input and output access waveguides couple to the multimode region at an angle set to match a local taper angle at the ends of the MMI region.

9. The multimode interference based coupler of claim 5, wherein the input and output access waveguides couple to the multimode region at an angle set to match a local taper angle at the ends of the MMI region.

10. The multimode interference based coupler of claim 3, wherein the taper shape is parabolic, hyperbolic, elliptical or cosinusoidal.

11. The multimode interference based coupler of claim 4, wherein the taper shape is parabolic, hyperbolic, elliptical or cosinusoidal.

12. The multimode interference based coupler of claim 1, wherein the taper maximum curvature, as characterized by the second derivative of the taper along the propogation axis, is limited such that the adiabaticity of guided modes is substantially maintained.

13. A 2x2 multimode based power splitter comprising:

(a) two input access waveguides for inputting an optical signal into a first end of the power splitter;

(b) two output access waveguides for outputting two images of the input optical signal from a second end of the power splitter; and

(c) a multimode region coupling the two input waveguides to the two output waveguides through which the input optical signal propagates along a propagation axis and is reimaged as two images of the input signal, the images having approximately half the intensity of the input signal, wherein

(i) the multimode region has two opposing sidewalls which define a width of the power splitter at each point along the propagation axis with the width of the first end and second end being substantially equal; and

(ii) the sidewalls are symmetrically tapered inward toward each other around a center line of the propagation axis wherein the taper is a continuous curve having a continuous derivative along the propagation axis with a single extrema within the MMI region where the derivative along the propagation axis is zero.

14. The power splitter of claim 13, wherein the taper is symmetric about a center line orthogonal to the propagation axis midway between the first end and the second end of the power splitter.

15. The power splitter of claim 14, wherein the taper shape is parabolic, hyperbolic, elliptical or cosinusoidal.

16. The power splitter of claim 13, wherein the input and output access waveguides couple to the multimode region at an angle set to match a local taper angle at the ends of the MMI region.

17. The power splitter of claim 13, wherein the taper maximum curvature, as characterized by the second derivative of the taper along the propogation axis, is limited such that the adiabaticity of guided modes is substantially maintained.